

## A revision of the holarctic *Chersotis andereggii* complex (Lepidoptera, Noctuidae)

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### Summary

In the Palaearctic region, *Chersotis andereggii* auct. has been found to include three species differing from each other mainly in male genital structures and in geographical range. *C. andereggii* (BOISDUVAL, 1834) occurs from Europe eastward to the Central Asiatic and Siberian mountains; the isolated Baltic population differs in appearance from that of the Alps and is described as a new subspecies. *C. acutangula* (STAUDINGER, 1892) stat. n. occurs in the Central Asiatic mountains. *C. juncta* (GROTE, 1878) is widely distributed in North America (the only Nearctic *Chersotis*), and is now reported from the eastern Palaearctic, having earlier been misidentified as *C. andereggii*. Adults and male genital structures of all three species, as well as the male genitalia of *C. rectangula* (DENIS & SCHIFFERMÜLLER, 1775), are described and illustrated, and the phylogeny of the group is discussed. Lectotypes are designated for *C. andereggii*, *C. acutangula* and *C. exclamans* (EVERSMANN, 1841), a junior synonym of *C. andereggii*. *C. sjuntensis* KUZNETZOV, 1958 is possibly a distinct species near *C. rectangula*, and *C. hamptoni* (A. BANG-HAAS, 1910) comb. n. is transferred to the genus *Chersotis*.

### 1. Introduction

BOISDUVAL (1834) first illustrated *Agrotis andereggii*, but six years later he (1840) called it *Chersotis rectangula* var. *andereggii*. In the latter publication he also mentioned localities and gave a description: Helvetia (Switzerland) and Diniæ (Digne, France), *minor, obscurior*. For more than 100 years the taxon remained as a variety of *C. rectangula* (DENIS & SCHIFFERMÜLLER, 1775) (e.g. STAUDINGER & REBEL 1901). BOURSIN (1952, 1954) showed that *andereggii* is a distinct species that can readily be distinguished from *C. rectangula* by the form of the male juxta, which is shield-shaped and flat in *C. andereggii*, but diamond-shaped with a central bulge in *C. rectangula* (fig. 2). BOURSIN (1957) noted that *acutangula* STAUDINGER, 1892 is a subspecies of *C. andereggii* and not of *C. rectangula*.



Fig. 1. From left to right : 1. *Chersotis rectangula* (D. & S.) Hungary, Josfafo 10.-15.9.1983 Z. Varga leg. ; 2. *C. andereggii* (BOISD.) U.S.S.R., SW Altai, Katanda 1200 m 26.-27.7.1983 Exp. MIKKOLA, HIPPA & JALAVA leg. ; 3. *C. juncta* (GROTE) U.S.A., Oregon, Morrow Co. 1100 m 9.8.1976 T. McCABE leg. ; 4. *C. acutangula* (STGR.) U.S.R.R., Uzbekistan, Samarkand 30.7.1892 O. HERZ leg. All specimens from the Zoological Museum, University of Helsinki.

*Chersotis andereggii* was reported as new to the Baltic area by PETERSEN (1924) on the basis of one moth from the northern coast of Estonia, but at least two specimens were caught as early as at the end of the 19th century in Estonia (PETERSEN 1924, SULCS & VIIDALEPP 1969). It was not until the 1980's that several more specimens were found in Estonia (VIIDALEPP oral comm.). The first record from Finland comes from the year 1960 (LINGTONBLAD 1960). Later, five moths were taken on the southern coast of Finland (fig. 4). Thus, until the 1980's, of the isolated northern population of *C. andereggii* only a dozen specimens were known.

In the course of our ongoing studies of Holarctic Noctuidae, it became apparent that *C. andereggii* auct. in the Palaearctic region includes three sibling species. One of these, *C. juncta* (GROTE, 1878), was previously thought to be restricted to the Nearctic. The third species, *C. acutangula* (STAUDINGER, 1892) has until now been considered as a Central Asiatic subspecies of *C. rectangula* and more recently of *C. andereggii*, though some confusion regarding its geographic distribution occurs in the literature (cf. BOURSIN 1948, KOVACS & VARGA 1973). The northern population of *C. andereggii* has an enigmatic distribution, since it is not easily understood why a high alpine species lives in the coastal areas of the Gulf of Finland (cf. PELLMYR & MIKKOLA 1985).

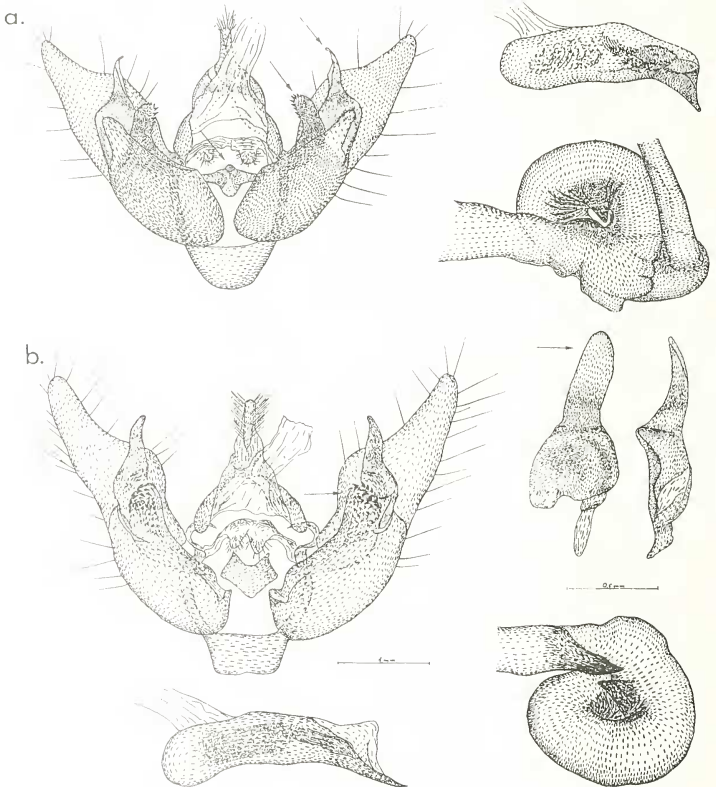
In the present paper we redescribe all these taxa, describe the new subspecies from the Baltic area and discuss the phylogeny and zoogeography of these taxa.

## 2. General description of the *Chersotis andereggii* complex

Appearance. Relatively small noctuids with uniformly dark greyish brown (*C. andereggii* and *juncta*) or grey-brown (*C. acutangula*) forewing. Reni-

form, orbicular and claviform spots large, outlined by a contrasting creamy white line. Lower portions of reniform and orbicular fused together; upper portions of these spots usually separated by a black bar. Antemedian line with black wedge at base of claviform spot; antemedian and postmedian lines with black spots at costa. Hindwing brown-grey, darker towards outer margin. Prothoracic collar black. Antenna filiform in both sexes.

Male genitalia (fig. 2). Valva broad basally, tapering apically, weakly sclerotized except sacculus. Harpe long extending well beyond costal margin of



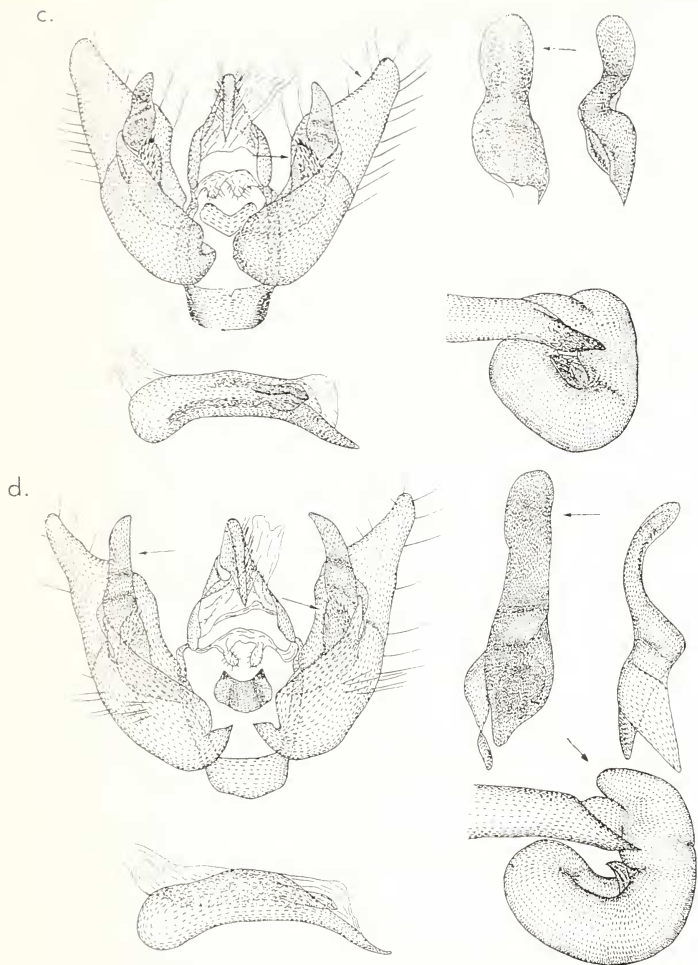


Fig. 2. Male genitalia of a. *Chersotis rectangula* Austria, Wien Prep. PG 318/1 (Mus. Paris) ; b. *C. andereggii* ssp. *arcana* ssp. n. Finland, Helsinki 18.-22.7.1968 Prep. PG 317/3 Paratype (Coll. JALAS) ; c. *C. juncta* U.S.S.R., Kamtshatka Prep. PG 317a/1 (Riksmuseet, Stockholm) ; d. *C. acutangula* U.S.S.R., Alai Prep. PG 317/c/1 Lectotype (Coll. Staudinger, Mus. Berlin). For *C. andereggii* complex (figs. 2b, c & d) : to the left opened valvae and aedeagus, and to the right harpe with double magnification shown from two directions and the everted vesica.

valva, strongly sclerotized and more or less spoon-like apically. Processus inferior (sensu BOURSIN 1954 : 254) strongly sclerotized, bent at an angle of nearly 90°, with apical and posterior portions covered with spines. Juxta shield-like, broadly V-shaped. Saccus strap-like, well sclerotized. Aedeagus with large and strongly sclerotized apical spine, slightly asymmetrical on right side. Everted vesica angled first ventrally posterior to apex of aedeagus, then coiled on the right through a total of 360° to project posteriorly. A sclerotized conical diverticulum near base of vesica pointing anteriorly. A large pouch at basal angle of vesica in one species and a slight extension only in others.

Female genitalia (fig. 3). Papillae anales with long setae laterally. Ostium bursae with large triangular plate, slightly asymmetrical to left (corresponding to spined tip of aedeagus). Ductus bursae with unsclerotized, folded pouch dorsally (corresponding to basal angle or pouch of vesica). A second pouch of ductus is sclerotized (corresponding to conical sclerotization of vesica). Appendix bursae coiled (corresponding to coil of vesica), with ductus seminalis at apex. Corpus bursae long and sac-like.

### 3. Key to male genitalia

1. Juxta diamond-shaped with distinct central bulge ; apex of harpe thin (fig. 2a) ..... *C. rectangula* (DENIS & SCHIFFERMÜLLER, 1775)
  - Juxta flat, broadly V-shaped, shield-like ; harpe apically flattened and more or less spoon-like ..... 2
2. Everted male vesica with dorsal diverticulum at base ; harpe long, projecting dorsally beyond valve for about one half of its length (fig. 2d) ..... *C. acutangula* (STAUDINGER, 1892) **stat. n.**
  - Vesica without dorsal diverticulum ; harpe shorter, only apical third extending beyond costal margin of valva ..... 3
3. Apical half of harpe tapering towards tip ; processus inferior apically broadly rounded, spines at the tip project at nearly right angle to axis of extension (fig. 2b) ..... *C. andereggii* (BOISDUVAL, 1834)
  - Apical part of harpe broad, spoon-like, asymmetric ; processus inferior tapering towards tip, spines at tip project nearly in the same direction as extension (fig. 2c) ..... *C. juncta* (GROTE, 1878)

### 4. Species of the *C. andereggii* complex

*Chersotis andereggii* (BOISDUVAL)

Figs. 1, 2, 3 and 5

*Agrotis andereggi* BOISDUVAL, 1834 : plate 76, fig. 6. Type locality : Valais, Switzerland.

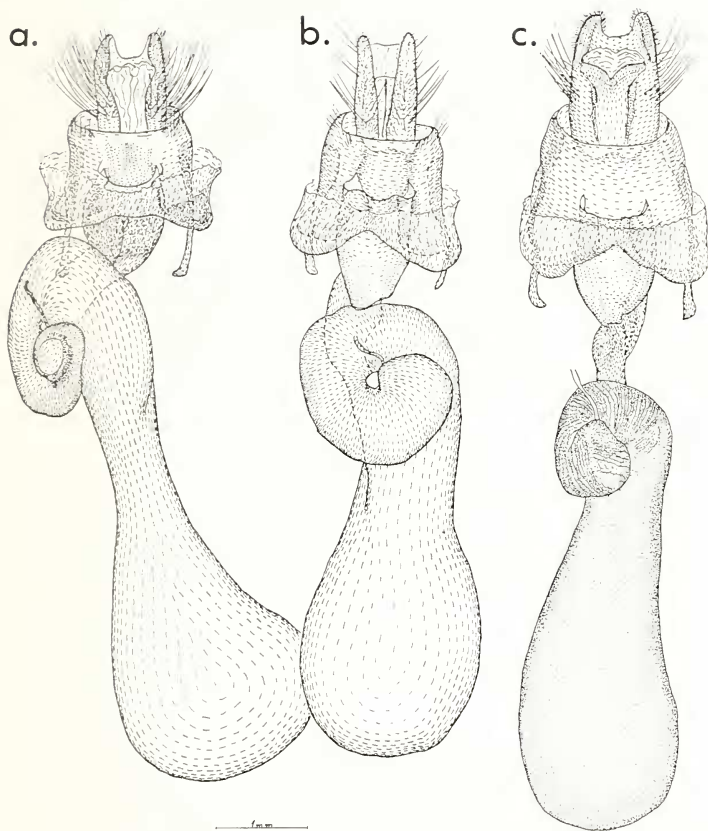


Fig. 3. Female genitalia of a. *Chersotis andereggii* ssp. *arcana* ssp. n. Finland, Helsinki 29.7.1963 Prep. PG 317/1 Paratype (Coll. MIKKOLA); b. *C. juncta* U.S.S.R., Kamchatka Prep. PG 317a/2 (Riksmuseet, Stockholm); c. *C. acutangula* U.S.S.R., Alai Prep. PG 317c/3 Paralectotype (Coll. STAUDINGER, Mus. Berlin).

*Agrotis rectangula* var. *anderreggii* (sic) ; BOISDUVAL 1840 : 103, no. 765.  
*Agrotis anderreggii* (sic) ; GUENÉE 1852 : no. 519.  
*Rhyacia rectangula* var. *anderreggii* ; STAUDINGER & REBEL 1901 : 142,  
no. 1229 a.  
*Agrotis rectangula* var. *anderreggii* ; CORTI 1929 : 1.  
*Chersotis anderreggii* ; BOURSIN 1948 : 131.  
*Agrotis exclamans* EVERS-MANN, 1841 : 27, Figs. 5 and 6. Type locality :  
South-western Ural mountains. Synonymized by GUENÉE 1852.

Description. Forewing particularly unicolorous, dark greyish brown. Transverse lines inconspicuous, except black patch on antemedian line near base of claviform spot. Creamy lining of maculation thin and relatively inconspicuous.

Male genitalia. Shape of male valva quite variable but relatively long and tapered in most specimens. Harpe not especially broad at apex, apical half slightly tapered, processus inferior apically broadly rounded, covered by spines, most of them pointing in direction of extension, but larger apical ones bent at nearly right angle to point medially. Juxta relatively long ("high" in a slide), about as long as wide.

Female genitalia. As described for species complex.

Type material. In the CORTI collection of Naturhistorisches Museum Basel, a male syntype with the following labels was found : "e coll. GUENÉE", "Ex Musaeo Ach. GUENÉE" and a big folded label, evidently written by GUENÉE, beginning : "*Anderreggii* (sic) Bd. Bdv. ic. pl. 76 — Gn. Spec. 619. 1-2. Valais (ANDEREGG.) — 3-4. Basses alpes ? (M. DONZEL). Malgr' ..." (see below). This male is here designated as LECTOTYPE.

The type material of *A. exclamans* was studied in ZIN, Leningrad, and the male labelled "Coll. EVERS-MANN/SPASK/Prep. PG 317" is here designated as LECTOTYPE.

Distribution (fig. 4). Occurs in several disjunct areas, at least in Europe with boreo-alpine distribution. It is known from the Pyrenees through the Alps to Austria and Italy, mainly at elevations of 1500 to 2500 m, and from the Baltic area (see below). To the east it occurs from the southern Ural mountains and Turkey eastward to Transcaucasia, Turkestan (up to 4500 m) and Central Asia (Kaputdzuh in Azerbaidzan ; Issykkul ; Tianschan ; Pontus), southern Siberian mountains, mainly at elevations of 500 to 1500 m (Altai ; Sayan ; the Baikal area) and several localities in Mongolia where it was found at elevations of 1150 to 1650 m (STAUDINGER 1892, KOVACS & VARGA 1973, see below under *C. acutangula*, FORSTER & WOHLFAHRT 1971, CALLE 1982).



Fig. 4. Schematized distribution map of the species of the *Chersotis anderreggii* complex. Black, no. 1 to 1 = populations of *C. anderreggii*, 2 = *C. a. anderreggii*, 3 = *C. anderreggii arcana* ssp. n. and 4 to 4 = *C. juncta*; striped = *C. acutangula*.

**Habitat.** In most part of its range the species occurs on alpine meadows and steppe slopes; in the Baltic area it seems to fly on relatively open and dry habitats of coastal areas, possibly also in open sunny pine forests.

**Remarks.** In the folded label of the lectotype (see above), the writer discusses the systematic position of "*anderreggii*" as follows (translated from French by E. DE BROS): "In spite of the opinion of most modern authors I persist not only to believe it as distinct from *rectangula* but even to consider it as not belonging to the same group. It is somehow a neighbour of *recussa* and the author (i.e. BOISDUVAL) makes a transition to *polygona*, however the last point must be discussed. But I cannot change my opinion about the validity of the species". The label must have been written by GUENEE, because the



contents, the handwriting and the taxonomic opinion do not fit BOISDUVAL. The same hand is visible in the labels of the type of *Noctua chardinyi* (BOISDUVAL). Both specimens probably changed hands from BOISDUVAL to GUENÉE, from him to OBERTHÜR and finally to CORTI.

The label reveals that ANDEREGG collected the species in Valais. At the time of writing of the label, four specimens existed, but it is possible that at the time of description of the species, BOISDUVAL only had those from Valais. As GUENÉE adds a question mark after Basses Alpes (Digne sec. BOISDUVAL 1840), we believe that the present specimen is from Valais.

### *Chersotis juncta* (GROTE)

Figs. 1, 2 and 3

*Agrotis juncta* GROTE, 1878 : 170. Type locality : Nova Scotia.

*Agrotis patefacta* SMITH, 1895 : 333. Type locality : Calgary, Alberta. Synonymized by SMITH, 1907 : 147.

*Chersotis rectangula* ssp. *andereggii*; CORTI, 1929 nec BOISDUVAL, 1834 (Kamchatka).

*Chersotis rectangula* ssp. *acutangula*; BOURSIN, 1948 nec STAUDINGER, 1892 (Kamchatka).

*Chersotis andereggii*; SEDYKH, 1979 nec BOISDUVAL, 1834 (Kamchatka).

Description. Forewing ground-color darker and still more unicolorous than in *C. andereggii*, blackish brown; creamy lining of maculation usually more conspicuous, especially that of larger claviform spot.

Male genitalia. Valva apically shorter and more roundish than in other species of complex. Apical third of processus inferior tapering towards apex, spines at tip of it project nearly along axis of process. Harpe short as in *C. andereggii*, but apically broad and with obliquely cut tip. Juxta shallower than in preceding species, belt-like, saccus also shallower, strap-like.

Female genitalia. As in *C. andereggii*, but with fewer setae on papillae anales.

Type material. The holotype in British Museum (Nat. Hist.), London, was studied by SMITH, 1907, and he synonymized his own *Agrotis patefacta* with *A. juncta*. Topotypical specimens are present in the Canadian National Collection, Ottawa. Lectotype of *A. patefacta* in USNM, Washington, designated by TODD 1982, was studied by JDL and KM.

Distribution (fig. 4). Occurs across Canada from Newfoundland and Nova Scotia westward to the Yukon and Alaska, and southward in the east to southern Quebec and northern Michigan and in the western mountains to northeastern Arizona and south-central California (FORBES 1954, ROCKBURNE & LAFONTAINE 1976). In the Palaearctic region it occurs at least in

Kamchatka and in Magadanskaya oblast' (CORTI 1929, SEDYKH 1979, KONONENKO oral comm.).

Habitat. Dry open conifer forests, in the south also alpine meadows.

Remarks. The species is now reported for the first time from the Palaearctic. CORTI (1929) identified specimens from Kamchatka (in Naturhistoriska Riksmuseet, Stockholm), as *Agrotis rectangula* var. *andereggii*, but BOURSIN (1948) "corrected" this as ssp. *acutangula*. This is surprising since *acutangula* is the most variegated taxon of the complex while *C. juncta* is the most unicoloured. Identification of specimens from Mongolia as *C. andereggii acutangula* by KOVACS & VARGA (1973) is also based on BOURSIN'S view, since he had seen the material in an early phase of the work (VARGA, oral comm.). They represent *C. andereggii* sensu stricto, however (VARGA in litt.).

We fully agree with SMITH (1907) on the synonymization of his *Agrotis patefacta* with GROTE'S *A. juncta*, even if the former was represented as a subspecies of the latter by FRANCLEMONT & TODD (1983). Though some eastern specimens are darker than most western ones, the variation is widely overlapping and corresponds in general to the more mesic collecting localities in the east.

*Chersotis acutangula* (STAUDINGER, 1892) stat. n.

Figs. 1, 2 and 3.

*Agrotis rectangula* var. *acutangula* STAUDINGER, 1892 : 355.

*Chersotis andereggii* ssp. *acutangula*; BOURSIN, 1948 : 131.

Description. Largest, palest and most contrastingly marked taxon of complex, forewing grey-brown with well-defined black transverse lines.

Male genitalia. Valva prominently tapering apically as in *C. andereggii* but distal part longer and narrower. Harpe longer than that of other species in complex, apically spoon-like, processus inferior apically slightly tapering, its apical spines project mediodorsally being intermediate between the other two taxa. Juxta broad and shallow as in *C. juncta*, but its posterior margin is arch-like and posterior tips are sharper and more strongly sclerotized. Everted vesica dorsally with a prominent basal dorso-posterior diverticulum which is absent in other taxa (fig. 2d).

Female genitalia. As described for complex; however, slides were not available for detailed study of ductus bursae (expected to show deeper posterior pouch than in other species).

Type material. The STAUDINGER collection (in Naturkundemuseum Berlin) contains the following syntypes: Alai 1 ♂ 1 ♀, Margelan 2 ♂♂ (probably mountains 30 km S of village), Samarkand 1 ♂ and Usgent 1 ♂. The male

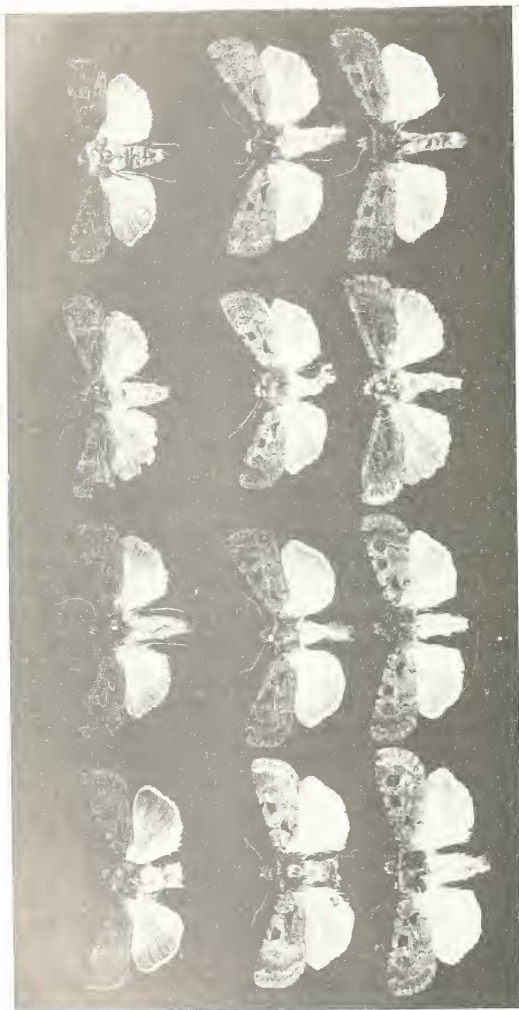


Fig. 5. Top row : *Chersotis andereggii arcana* ssp. n., from left to right : Helsinki 1968, Borgå lk. 1977, Hittis 1960 (holotype) and Helsinki 1963 (cf. Chapter Type material). Two lower rows : *C. a. andereggii* from the Alps (Mus. Paris), first from left to right 4 males : Larche, Basses Alpes ; Tyrol ; La Bessée, Hautes Alpes, and then 3 females and one male : Nevache ; Davos, Graubünden ; Zermatt, Penniner Alps 2 specs.

from Alai, Fig. 2d (♂ genitalia) in this article and Pl. 6 : Fig. 21 in O. BANG-HAAS (1922), is hereby designated as LECTOTYPE.

Distribution (fig. 4). Central Asia : Tianschan, Alai, Transalai, Kungei-Alatau, Gissarskiy range, Peter I range, Tarbagatai, Pamir (Samarkand, Fergana, Usgent, Margelan, Sarawschan). Elevations of 2000-3000 m.

Habitat. Dry, steppe-like mountain slopes sparsely covered with *Juniperus* trees (VARGA in litt.).

## 5. Subspecies of *C. andereggii*

*Chersotis andereggii* ssp. *arcana* MIKKOLA ssp. n.

Fig. 2, 3 and 5.

Description. Wingspan (measuring accuracy 0.5 mm) : Males, mean = 31.75 mm (n = 2, range 31.5-32.0) ; females, mean = 30.7 mm (n = 5, S.D. = 0.86, range = 29.5-31.5). Smaller (but see below) and darker than *C. andereggii* ssp. *andereggii* (BOISDUVAL), and with more unicolorous forewing (fig. 5). Forewing groundcolour dark greyish brown ; maculation and lines correspond to those of *C. a. andereggii*, but are weaker : e.g. hind part of antemedian line usually just darker hint (black in *C. a. andereggii*), postmedian line hardly ever filled with light colour and creamy line around maculation in most cases quite inconspicuous. Hindwing characteristic : outer third, or more, suffused with colour nearly as dark as forewing (in *C. a. andereggii* hindwing is whitish with slightly darker colour near margin and particularly at veins).

Male genitalia (fig. 2b). Identical with specimens from the Alps.

Female genitalia (fig. 3a). Identical with specimens from the Alps.

Type material. Holotype ♀ : "Fennia, Ab : Hitis 25.7.1960 LINGONBLAD leg." (Mus. Zool. Helsinki). Paratypes : Finland : 1 ♂ "Fennia, Helsinki, Vallisaari 18.-22.7.1968 Ilkka JALAS leg. ; prep. ♂ 317/3 P. GROTFELT" (Coll. JALAS) ; 1 ♀ "Suomi, N Helsinki, Merikatu 29.7.1963 H. MIKKOLA leg. ; prep. ♀ 317/4 P. GROTFELT" (Coll. MIKKOLA) ; 1 ♀ "Fennia, N : Borga lk., Illby 6706 : 432 3.-9.8.1977 M. LANDTMAN leg." (Coll. LANDTMAN) ; 1 ♂ U : Helsinki, Isosaari 666 : 39 16.-28.7.1982 E. & L. LAASONEN leg. (Coll. LAASONEN) ; 1 ♂ U : Vantaa 668 : 39 14.-20.7.1983, J. WETTENHOVI & P. KOSKINEN leg. Estonia : 1 ♀ "Narva 82 Merekvel, Coll. FILIPIJEV" (ZIN, Leningrad) ; 1 ♂ "Coll. FILIPIJEV" (ZIN, Leningrad ; from outer appearance of the moth and from collecting areas of FILIPIJEV this was interpreted to be the second specimen mentioned by PETERSEN 1924) ; 1 ♀ Tiitsoo 30.7.1905 E (sic) PETERSEN leg., studied from the good photograph presented by SULCS

& VIIDALEPP (1969). All the Finnish moths have been collected at light, but that from Tiitsoo, Estonia, with baits.

Etymology. Lat. fem. *arcana* = secret, mysterious ; from the puzzling rarity and locality of the taxon.

Remarks : An analysis of the diagnostic characters. 2 ♂♂, 5 ♀♀ from the Baltic area were compared with 11 ♂♂, 3 ♀♀ from the Alps. Characters expected to be typical of the Baltic moths were taken as minus : 1. Wing span at most 32.0 mm, 2. darkness of forewing grade 4 (scale : 1 = light brown, 2 = light medium brown, 3 = dark medium brown, 4 = dark brown), 3. orbicular spot without sharp border line, maculation of same colour with wing (not distinctly greyish), 4. postmedian line not sharply defined or filled with light colour, 5. hind part of antemedian line not visible or just faint stripe, 6. subterminal line obscure or mere borderline between darker and lighter colour and 7. outer part of hindwing distinctly dark, also between the veins (alternative : dark only near margin, veins darker than groundcolour).

The wing span did not differ in males from the Baltic area (mean = 31.75 (31.5 + 32.0) and from the Alps ( $31.7 \pm 1.52$ ,  $n = 11$ ). However, there was a significant difference in the females :  $30.7 \pm 0.86$ ,  $n = 5$  and  $34.0 \pm 1.00$ ,  $n = 3$ , respectively ( $t = 5.03$ ,  $df = 6$ ,  $p < 0.005$ ). Darkness of hindwing was the most distinctive single character in both sexes : the hindwings of the lightest moth from the Baltic area (from Tiitsoo) were similar to the darkest from the Alps (fig. 5, bottom row, second from right). The mean value of the Baltic moths was  $-4.00 \pm 1.82$ , but that of the moths from the Alps  $+4.42 \pm 1.60$ . When all the characters are taken into account, not a single specimen can be mistaken to originate in a wrong area : the minimum value for the Baltic area was  $-2.00$  (2 moths) but  $+2.00$  (3 moths) for the Alps.

The six moths available from the southern Ural mountains had similar hindwing to that in the Alps, but the forewing was more unicolorous, yet more variegated than in the Baltic area. This appearance may be common for the whole of Siberia and would warrant, when more material is available, description of an additional subspecies.

## Discussion

Phylogenetic relationships of taxa. Our reconstructed phylogeny of the species in the *C. andereggii* complex is shown in fig. 6. Two other closely related complexes are included for out-group comparison : the *C. rectangula* (DENIS & SCHIFFERMÜLLER, 1775) complex (also including *C. sjuntensis* KUZNETZOV, 1958) and the *C. ocellina* (DENIS & SCHIFFERMÜLLER, 1775) complex (also including *C. transiens* (STAUDINGER, 1896) and *C. alpestris*

(BOISDUVAL, 1832); *C. oreina* DUFAY, 1984, bona species, not available). Other species studied were *Chersotis hampsoni* (A. BANG-HAAS, 1910: 34) **n. comb.**, *C. cuprea* (Denis & Schiffermüller, 1775) and *C. multangula* (HÜBNER, 1803).

*C. sjuntensis* was described on the basis of one female from Turkmenistan, Sjunt. We are afraid that KUZNETZOV (1958) compared these genitalia to those of *C. andereggii* and not to those of *C. rectangula*, because both were called “*rectangula*” by KOZHANCHIKOV (1937). In the type series of *C. acutangula* (Naturkundemuseum Berlin) there is an unknown *Chersotis* male from Zeitun, Central Asia, which is close to *C. rectangula*, but seems to differ from this in the coiling of vesica. We assume that this is the undescribed male of *C. sjuntensis*, but we refrain from describing it because of lack of exact knowledge about the association of the male with the described female.

The *C. rectangula* and *C. andereggii* complexes are linked together by three synapomorphies. 1. The pyramid-like right-hand basal sclerotization of vesica seems to be a synapomorphy unique to these complexes. 2. All species

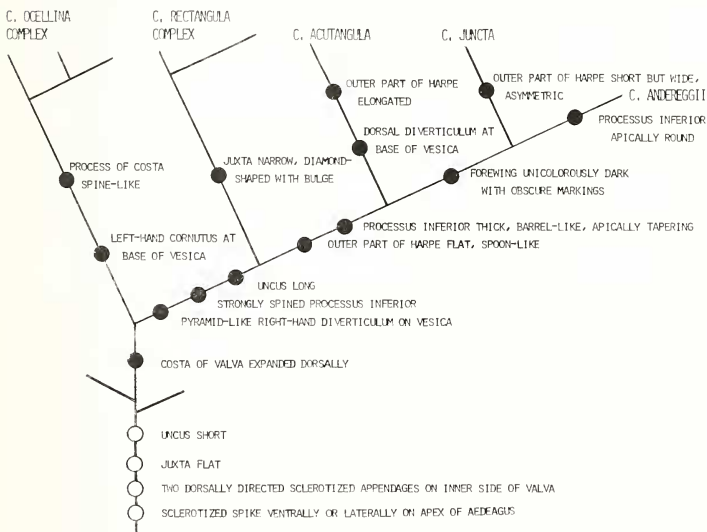


Fig. 6. A provisional cladogram for the *C. andereggii* complex and two closely related groups. The open symbols denote some generic characters of *Chersotis*, the filled ones are apomorphies of the present complexes.

have a broad, unsclerotized costal lobe in the dorsal margin of valva. In the same position, the species of the *C. ocellina* complex have a quite different sharp and sclerotized costal process. 3. The strong spiny armour of processus inferior is typical of these species. Of other species studied, only *C. hamptoni* has spines on the processus, but they are weak.

The structure of the juxta and processus inferior as well as the coiling of the vesica link the species of the *C. andereggii* complex together. The relationship of these species to each other is not easily understood, the solution being mainly dependent on the interpretation of the polarity of the character states of basal diverticulum of vesica (present/absent). The basal diverticulum is present, though not in exactly similar form, in the *C. rectangula* complex and in *C. multangula*, but as it is absent in most species, it must be an apomorphic condition. The diverticulum of *C. acutangula* would then be an autapomorphy without significance in the cladistic analysis. The polarity of the character states of the processus inferior and harpe can hardly be determined. We therefore tentatively group *C. andereggii* and *C. juncta* on the basis on their similar general appearance. They would be sister species and east/west counterparts. This similarity is contrasted by the larger size, and paler colour and better defined maculation of the forewing in *C. acutangula*. The harpe with the distal part clearly longer than the basal part is probably also an autapomorphy of this species (about 2/3 of the basal part in the two other species).

The *C. andereggii* complex might have originated in the Central Asian mountains where *C. acutangula* now lives. The recent *C. andereggii* may have spread only secondarily in that area. As *C. juncta* is the only *Chersotis* species in North America and as it does not show any subspecific variation, we suggest that it has a Beringian origin and has only relatively recently acquired its wide distribution in North America.

Zoogeography of *C. andereggii arcana*. 7000-8000 years ago a dry climate favourable for *C. andereggii* prevailed in Europe (see WARNECKE 1953, HOLDHAUS 1954). Later the forests again spread over vast areas and the area of distribution of the species was split into parts. The case of *C. andereggii arcana* shows us that a period of about 7000 years and equally many generations have been enough for a change of appearance but not enough for a change in the genitalia. The relative difference in the size of females points towards a considerable ecological specialization during this time span.

Alternatively, the isolation is older: *C. a. andereggii* would have overwintered the Ice Ages in the southern Central European mountains and *C. andereggii arcana* would have spread to the Baltic area from the east. Then *C. andereggii arcana* would be more closely related to the populations of the southern Ural mountains than to those of the Alps. The uniform forewing

colouration speaks for this ; size measurements of females relative to males could give an answer to this.

To the east and south-east the nearest record is about 2000 km away (Orenburg). The species certainly does not live in the areas between, because it has not been mentioned in the respective faunas (Leningrad area : DERZHAVETZ *et al.* 1986 ; Pskov region : POSPELOV *et al.*, 1979 ; White-Russia : MERZEYEVSKAYA 1971 ; Moscow-Kaluga area : SIROTIN unpubl. ; Kirov : CHERNIN 1974 ; Komi : SEDYKH unpubl.). To the south the closest occurrences of the species are about 1600 km away.

A few other xerophilic/montane lepidopterans have more or less isolated occurrences along the coasts of the Baltic Sea (see NORDSTRÖM *et al.*, 1969) : e.g. *Athetis lepigone* (MÖSCHL.), *Rhyacia grisescens* (FABR.), *Standfussiana lucernea* (L.) and *Eupithecia pernotata* (GUENÉE). The general distribution of the last mentioned species is particularly similar to that of *C. andereggii* with an isolated occurrence around the Gulf of Finland (*E. pernotata* ssp. *enicitata* PELLMYR & MIKKOLA, 1985). All these species might have reached the Baltic area in the same dry postglacial period. The dry and sunny summer of the archipelagoes and coastal areas of the Gulf of Finland seems to be the key factor of their northern distribution.

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